Agency for Healthcare Research and Quality
Advancing Excellence in Health Care

NATIONAL GUIDELINE CLEARINGHOUSE

General

Guideline Title

The diagnosis and management of traumatic atlanto-occipital dislocation injuries. In: Guidelines for the management of acute cervical spine and spinal cord injuries.

Bibliographic Source(s)

Theodore N, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Rozzelle CJ, Ryken TC, Walters BC, Hadley MN. The diagnosis and management of traumatic atlanto-occipital dislocation injuries. In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2013 Mar;72(Suppl 2):114-26. [80 references] PubMed

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

The rating schemes used for the strength of the evidence (Class I-III) and the levels of recommendations (Level I-III) are defined at the end of the "Major Recommendations" field.

Recommendations

Diagnostic

Level I

- Computed tomography (CT) imaging to determine the condyle-C1 interval (CCI) in pediatric patients with potential atlanto-occipital dislocation (AOD) is recommended.

Level III

- If there is clinical or radiographic suspicion of AOD, CT of the craniocervical junction is recommended. The CCI determined on CT has the highest diagnostic sensitivity and specificity for AOD among all radiodiagnostic indicators in pediatric patients. The utility of CCI in adult patients has not been reported.
- A lateral cervical radiograph is recommended for the diagnosis of AOD. If a radiological method for measurement is used to determine AOD on the lateral radiograph, the basion-axial interval-basion dental interval (BAI-BDI) method is recommended. The presence of upper cervical prevertebral soft tissue swelling (STS) on an otherwise non-diagnostic plain cervical radiograph should prompt CT imaging to rule

out AOD.

Treatment

Level III

- Treatment with internal fixation and fusion using one of a variety of methods is recommended.
- Traction is not recommended in the management of patients with AOD, and is associated with a 10% risk of neurological deterioration.

Summary

AOD is an uncommon traumatic injury that can be difficult to diagnose and is frequently missed on initial lateral cervical spinal radiographs. AOD is often associated with severe traumatic brain injuries. Patients who survive AOD injuries often have neurological impairment including lower cranial nerve deficits, unilateral or bilateral weakness, or quadriplegia. Nearly 20% of patients with acute traumatic AOD will have a normal neurological examination on presentation. The lack of localizing physical/neurological examination findings and/or global neurological deficits from severe brain injury may impede/hinder the diagnosis of AOD in patients with normal-appearing initial cervical radiographs. A high index of suspicion must be maintained in order to diagnose AOD. Prevertebral soft tissue swelling on a lateral cervical radiograph or craniocervical subarachnoid hemorrhage on axial CT images have been associated with AOD and should prompt consideration of the diagnosis. Additional imaging including CT and magnetic resonance imaging (MRI) may be required to confirm the diagnosis of AOD if plain radiographs are inadequate. The CCI interval as determined on CT imaging has the highest diagnostic sensitivity and sensitivity for AOD among all other radio-diagnostic indicators.

All patients with AOD should be treated. Without treatment, nearly all patients developed neurological worsening, many of whom never fully recover. Treatment of AOD with traction is not recommended. Treatment with external immobilization has been used successfully in selected patients but has a high failure rate. Craniocervical fixation and fusion is recommended for the treatment of patients with acute traumatic AOD.

Definitions:

Rating Scheme for the Strength of the Evidence: Modified North American Spine Society Schema to Conform to Neurosurgical Criteria as Previously Published and for Ease of Understanding and Implementation: Levels of Evidence for Primary Research Question[a]

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
I	High-quality randomized controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals	Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä¸ statistic ≥0.60 or an intraclass correlation coefficient of ≥0.70
	Systematic review[b] of Class I randomized controlled trials (and study results were homogeneous[c])	Systematic review[b] of Class I studies	
II	Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization)	Development of diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä¸ statistic of 0.40–0.60 or an intraclass correlation coefficient of 0.50–0.70
	Prospective[d] comparative study[e]	Systematic review[b] of Class II studies	
	Systematic review[b] of Class II studies or Class I studies with inconsistent results	Study of nonconsecutive patients; without consistently applied reference "gold" standard	
	Case-control study[g]	Systematic review[b] of Class III studies	

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
	Retrospective[f] comparative study[e] Systematic review[b] of Class II studies	Case-control study[g]	
III	Case series[h]	Poor reference standard	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä¸ statistic of <0.40 or an intraclass correlation coefficient of <0.50
	Expert opinion	Expert opinion	

[a]A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.

[b]A combination of results from 2 or more prior studies.

[c]Studies provided consistent results.

[d]Study was started before the first patient enrolled.

[e]Patients treated 1 way (e.g., halo vest orthosis) compared with a group of patients treated in another way (e.g., internal fixation) at the same institution.

[f]The study was started after the first patient was enrolled.

[g]Patients identified for the study on the basis of their outcome, called "cases" (e.g., failed fusion), are compared with those who did not have outcome, called "controls" (e.g., successful fusion).

[h]Patients treated 1 way with no comparison group of patients treated in another way.

Levels of Recommendation

Level I	Generally accepted principles for patient management, which reflect a high degree of clinical certainty (usually this requires Class I evidence which directly addresses the clinical questions or overwhelming Class II evidence when circumstances preclude randomized clinical trials)
Level II	Recommendations for patient management which reflect moderate clinical certainty (usually this requires Class II evidence or a strong consensus of Class III evidence)
Level III	Other strategies for patient management for which the clinical utility is uncertain (inconclusive or conflicting evidence or opinion)

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Traumatic atlanto-occipital dislocation injuries

Guideline Category

Diagnosis

Management

Treatment

Clinical Specialty

Emergency Medicine

Neurological Surgery

Neurology

Orthopedic Surgery

Radiology

Intended Users

Advanced Practice Nurses

Hospitals

Nurses

Physician Assistants

Physicians

Guideline Objective(s)

To update the medical evidence on the diagnosis and treatment of atlanto-occipital dislocation (AOD) since an earlier publication

Target Population

Patients with suspected or confirmed traumatic atlanto-occipital dislocation (AOD) injuries

Interventions and Practices Considered

Diagnosis

1. Computed tomography (CT) imaging to determine the condyle-C1 interval (CCI)
2. Lateral cervical radiography
3. Use of the basion-axial interval-basion dental interval (BAI-BDI) method to determine atlanto-occipital dislocation (AOD)

Treatment/Management

1. Internal fixation and fusion
2. Traction (not recommended)

Major Outcomes Considered

- Diagnostic specificity and sensitivity of imaging tests
- Safety and efficacy of various treatment modalities for atlanto-occipital dislocation injuries (AOD)

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Search Criteria

A National Library of Medicine computerized literature search of publications from 1966 to 2011 was performed using the following headings: "atlanto-occipital joint" and "dislocation." The search was limited to the English language and human studies. An exploded search of these headings led to 522 and 11,257 citations, respectively. A subset of 178 citations contained both headings. The references of the identified articles were reviewed to identify additional case reports. The articles were reviewed using the following criteria for inclusion in diagnosis: human survivors, type of traumatic atlanto-occipital dislocation, and plain radiographic findings. The articles were also reviewed using the following criteria for inclusion in treatment: human survivors, type of traumatic atlanto-occipital dislocation, management, and outcome. The observations from the published reports were combined because the usual methods for analysis were precluded by the infrequent observation of this injury. The type of dislocation was classified according to Traynelis et al into Type I (anterior), Type II (longitudinal), and Type III (posterior) dislocations. Lateral, rotational, and multi-directional dislocations that could not be classified into 1 of these 3 types were considered separately and are notated as "other Type." The duration of follow-up ranged from none reported to 4 years. Of the articles meeting the diagnostic selection criteria reported, 68 articles with 105 patients provided data on 38 Type I, 45 Type II, 4 Type III, and 18 other Types of AOD. Two of these articles included 1 patient each from 2 previously published individual case reports. Of the articles meeting the treatment selection criteria, 56 articles with 84 patients provided data on 31 Type I, 33 Type II, 4 Type III, and 16 other types of AOD. Two of these articles included 1 patient each from 2 previously published individual case reports. The information provided by these reports was compiled and scrutinized and make up the basis for this guideline.

Number of Source Documents

- Of the articles meeting the diagnostic selection criteria reported, 68 articles with 105 patients provided data on 38 Type I, 45 Type II, 4 Type III, and 18 other Types of atlanto-occipital dislocation (AOD).
- Of the articles meeting the treatment selection criteria, 56 articles with 84 patients provided data on 31 Type I, 33 Type II, 4 Type III, and 16 other Types of AOD.
- Summaries of these reports are provided in Evidentiary Table format (refer to Tables 1 and 2 in the original guideline document).

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Rating Scheme for the Strength of the Evidence: Modified North American Spine Society Schema to Conform to Neurosurgical Criteria as Previously Published and for Ease of Understanding and Implementation: Levels of Evidence for Primary Research Question[a]

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	difference or no statistically significant difference but narrow confidence intervals	consecutive patients (with universally applied reference "gold" standard)	reliability is represented by a Ä statistic ≥0.60 or an intraclass correlation coefficient of ≥0.70
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Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Selected articles were carefully reviewed by the authors. Evidentiary tables were created (refer to Tables 1 and 2 in the original guideline document) that reflected the strengths and weaknesses of each article.

On occasion, the assessed quality of the study design was so contentious and the conclusions so uncertain that the guideline authors assigned a lower medical evidence classification than might have been expected without such a detailed review. In every way, adherence to the Institute of Medicine's criteria for searching, assembling, evaluating, and weighing the available medical evidence and linking it to the strength of the recommendations presented in this document was carried out.

Articles that did not achieve immediate consensus among the author group were discussed extensively until a consensus was reached. Very few contributions required extensive discussion. Most articles were easily designated as containing Class I, II, or III medical evidence using the criteria set forth by the author group at the initiation of the literature evaluation process (see the "Rating Scheme for the Strength of the Evidence" field).

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The current author group was selected for its expertise in spinal surgery (both neurosurgical and orthopedic), neurotrauma, clinical epidemiology, and, in several cases, prior experience with guideline development. The topics chosen for inclusion in this iteration of these guidelines are contemporary and pertinent to the assessment, evaluation, care, and treatment of patients with acute cervical spine and/or spinal cord injuries.

Rating Scheme for the Strength of the Recommendations

Levels of Recommendation

Level I	Generally accepted principles for patient management, which reflect a high degree of clinical certainty (usually this requires Class I evidence which directly addresses the clinical questions or overwhelming Class II evidence when circumstances preclude randomized clinical trials)
Level II	Recommendations for patient management which reflect moderate clinical certainty (usually this requires Class II evidence or a strong consensus of Class III evidence)
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Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Not stated

Description of Method of Guideline Validation

Not applicable

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Accurate diagnosis and appropriate management of traumatic atlanto-occipital dislocation (AOD) injuries

Potential Harms

Since 7 of 12 (58%) patients managed with external immobilization either deteriorated neurologically or failed to achieve craniocervical stability without surgical internal fixation and fusion, treatment of atlanto-occipital dislocation (AOD) with external immobilization alone should be considered with caution.

Qualifying Statements

Qualifying Statements

- Medical evidence-based guidelines are not meant to be restrictive or to limit a clinician's practice. They chronicle multiple successful treatment options (for example) and stratify the more successful and the less successful strategies based on scientific merit. They are not absolute, "must be followed" rules. This process may identify the most valid and reliable imaging strategy for a given injury, for example, but because of regional or institutional resources, or patient co-morbidity, that particular imaging strategy may not be possible for a patient with that injury. Alternative acceptable imaging options may be more practical or applicable in this hypothetical circumstance.
- Guidelines documents are not tools to be used by external agencies to measure or control the care provided by clinicians. They are not medical-legal instruments or a "set of certainties" that must be followed in the assessment or treatment of the individual pathology in the individual patients we treat. While a powerful and comprehensive resource tool, guidelines and the recommendations contained therein do not necessarily represent "the answer" for the medical and surgical dilemmas faced with many patients.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Mobile Device Resources

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Theodore N, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Rozzelle CJ, Ryken TC, Walters BC, Hadley MN. The diagnosis and management of traumatic atlanto-occipital dislocation injuries. In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2013 Mar;72(Suppl 2):114-26. [80 references] PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2013 Mar

Guideline Developer(s)

American Association of Neurological Surgeons - Medical Specialty Society

Congress of Neurological Surgeons - Professional Association

Source(s) of Funding

Congress of Neurological Surgeons

Guideline Committee

Guidelines Author Group of the Joint Section of Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons

Composition of Group That Authored the Guideline

Authors: Nicholas Theodore, MD, Division of Neurological Surgery, Barrow Neurological Institute, Phoenix, Arizona; Bizhan Aarabi, MD, FRCSC, Department of Neurosurgery, University of Maryland, Baltimore, Maryland; Sanjay S. Dhall, MD, Department of Neurosurgery, Emory University, Atlanta, Georgia; Daniel E. Gelb, MD, Department of Orthopaedics, University of Maryland, Baltimore, Maryland; R. John Hurlbert, MD, PhD, FRCSC, Department of Clinical Neurosciences, University of Calgary Spine Program, Faculty of Medicine, University of Calgary, Calgary, Alberta, Canada; Curtis J. Rozzelle, MD, Division of Neurological Surgery, Children's Hospital of Alabama, University of Alabama at Birmingham, Birmingham, Alabama; Timothy C. Ryken, MD, MS, Iowa Spine & Brain Institute, University of Iowa, Waterloo/Iowa City, Iowa; Beverly C. Walters, MD, MSc, FRCSC (*Lead Author*), Division of Neurological Surgery, University of Alabama at Birmingham, Birmingham, Alabama, Department of Neurosciences, Inova Health System, Falls Church, Virginia; Mark N. Hadley, MD (*Lead Author*), Division of

Neurological Surgery, University of Alabama at Birmingham, Birmingham, Alabama

Financial Disclosures/Conflicts of Interest

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this guideline.

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) and EPUB for eBook devices from the Neurosurgery Web site .

Availability of Companion Documents

The following are available:

- Foreword. Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):1. Electronic copies: Available in Portable Document Format (PDF) from the Neurosurgery Web site .
- Commentary. Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):2-3. Electronic copies: Available in PDF from the Neurosurgery Web site .
- Introduction to the guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):5-16. Electronic copies: Available in PDF from the Neurosurgery Web site .
- Methodology of the guidelines for management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):17-21. Electronic copies: Available in PDF from the Neurosurgery Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on July 9, 2013. The information was verified by the guideline developer on October 3, 2013.

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